NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Joseph M. Farley - Unit 1	0 5 0 0 0 3 4 8	1 OF 0 9

TITLE (4)
Potential Inoperability Of The A Train Charging Pump Due To Gas Accumulation

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 3	0 1	8 8	8 8	— 0 0 6 —	0 0	0 3	3 1	8 8	J. M. Farley - Unit 2	0 5 0 0 0 3 6 4
										0 5 0 0 0

OPERATING MODE (9): 1
POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	X 50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
20.405(a)(1)(ii)	X 50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (AREA CODE)
J. D. Woodard, General Manager-Nuclear Plant	2 0 5 8 9 9 - 5 1 5 6

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE) X NO

EXPECTED SUBMISSION DATE (15): MONTH | DAY | YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

At approximately 1700 on 3-1-88 it was determined that hydrogen was accumulating in the supply line from the residual heat removal (RHR) pump to the charging pump suction for the A train on each unit. The amounts of hydrogen that accumulated could possibly have caused damage to the A train charging pump if the recirculation phase of safety injection (i.e., suction from the containment sump via RHR pump to the charging pump) had been required. Normal charging pump operation and the injection phase of safety injection were not affected by the hydrogen accumulations.

The hydrogen was vented from the piping and a periodic venting program was initiated to ensure the hydrogen accumulation was held to acceptable levels. The normally operating charging pump on each unit has been established as the B or C pump because of the identified propensity for gas accumulation in the supply line from the residual heat removal pump to the charging pump suction for the A train when the A pump is running.

This event was caused by the piping configuration in that the layout of the A train supply line from RHR piping allowed hydrogen to accumulate.

IE22
1/1

Plant and System Identification

Westinghouse - Pressurized Water Reactor
Energy Industry Identification System codes are identified in the text as [XX].

Summary of Event

At approximately 1700 on 3-1-88 it was determined that hydrogen was accumulating in the supply line from the residual heat removal (RHR) [BP] pump to the charging pump suction [BJ] for the A train on each unit. The amounts of hydrogen that accumulated could possibly have caused damage to the A train charging pump if the recirculation phase of safety injection (i.e., suction from the containment sump via RHR pump to the charging pump) had been required. Normal charging pump operation and the injection phase of safety injection were not affected by the hydrogen accumulations.

The hydrogen was vented from the piping and a periodic venting program was initiated to ensure the hydrogen accumulation was held to acceptable levels. The normally operating charging pump on each unit has been established as the B or C pump because of the identified propensity for gas accumulation in the supply line from the residual heat removal (RHR) pump to the charging pump suction for the A charging pump when the A train is running.

Description of Event

At approximately 0315 on 2-26-88, while the unit was in Mode 1 operating at 100% reactor power, the high point vent valve (V483) on the Unit 1 A train RHR to charging pump suction was opened to collect a water sample. When V483 was opened, only gas was vented. The venting was continued and a water sample was finally obtained from V483. As a result of this venting, the volume control tank (VCT) [CB] level decreased approximately 30%. At 13.99 gal/%, this equates to about 420 gallons of water displacing the gas volume.

Plant personnel did not know the composition of the gas and started an investigation to determine the source of the gas. It was believed that after venting, the gas problem was resolved except for determining the source.

At approximately 1430 on 2-28-88, the Unit 1 B train RHR to charging pump suction was vented as part of the investigation and no gas was observed.

At approximately 1800 on 2-29-88, the Unit 2 A train RHR to charging pump suction was vented as a continuation of the investigation of the Unit 1 occurrence. The results were similar to those obtained from the Unit 1 A train venting and about 310 gallons of water displaced the gas volume. The Unit 2 B train RHR to charging pump suction was vented and no gas was observed.

At approximately 1700 on 3-1-88, the Unit 1 A train RHR to charging pump suction was vented again. The volume decrease in the VCT level was 152 gallons. The gas was sampled and the results indicated that it was 98.09% hydrogen, 1.65% nitrogen, and 0.26% oxygen. This is comparable with sample results from the VCT gas.

At approximately 0300 on 3-2-88, the Unit 2 A train RHR to charging pump suction was vented again and no gas was observed. At approximately 1620 on 3-2-88, the Unit 1 A train RHR to charging pump suction was vented and the equivalent of five gallons of gas was vented.

The 1A charging pump was the operating pump on Unit 1 and the 2B charging pump was the operating pump on Unit 2 for all venting evolutions noted above.

The piping elevations for the A and B train RHR to charging pump suction lines are not the same on both units. The A train piping high point on Unit 1 is 133' and on Unit 2 it is 132'6". The B train elevations are approximately 114' for both units. The VCT is located on the 121' elevation and is 9'3" in height.

Subsequent investigation showed that significant hydrogen accumulation occurs in the A train RHR to charging pump suction piping on each unit and is most prevalent when the A pump is operating.

Background Information

On 11-6-79, during startup testing of Unit 2, an Operating Change Request (OCR) was generated by the startup organization to request a solution to the potential for the accumulation of gas pockets in the suction line to the Unit 2 pumps. This OCR was prompted by the fact that during the Unit 2 cold hydro test, with a nitrogen overpressure in the VCT and C pump running, gas was found to accumulate in the suction loop of the idle B pump. The OCR suggested a system modification to route a line from the high points of the inverted loops in the pump's suction back to the VCT gas discharge line. The OCR recognized that the suction of the A pump could probably not be vented back to the VCT since the high point in the suction to the A pump is actually higher than the VCT level. The OCR proposed that the A pump vent be piped up to a drain header to allow for periodic venting. The OCR also recognized that the pump suction pressure at the elevation of the inverted loops could be less than the pressure in the VCT with normal charging flowrates, such that the suggested venting arrangements would not be feasible without system modification. The OCR did not propose any changes to Unit 1.

On 6-10-81, a Production Change Request (PCR) for Unit 2 was generated by the plant staff. The PCR identified the problem that, with charging pumps 2A or 2C in operation and 2B charging pump idle, a volume of gas collects in the suction line of the 2B pump. The plant staff only identified the problem of gas accumulation in the 2B pump when idle due to the fact that the 2B pump suction pipe routing is significantly different from the 2A and 2C pipe routing. The plant did not recognize the potential for gas accumulation in the A train RHR to charging pump suction piping.

On 8-7-81, it was determined, following an on site evaluation by Bechtel engineers, that the only temporary solution to the accumulation of hydrogen gas in the suction side of the Unit 2 B charging pump was continuously running the 2B pump. The permanent fix identified on 8-7-81 was to install four (4) 3/4" air operated - fail closed valves and route the pump suction vents back to the gas space in the VCT.

On 3-22-82, Westinghouse recommended the installation of vent lines from the charging pump suction lines to the VCT gas space to eliminate the accumulation of gases in the charging pump suction line inverted loops for the 2B and 2C pumps. Westinghouse recommended a water seal also be added to the 2A pump tee connection of the RHR to charging pump recirculation line and the charging pump 2A suction line, as well as vent line due to the fact that the 2A charging pump suction piping high point is higher than that of the VCT water level and would therefore not vent to the VCT. The Westinghouse proposal was applicable to Unit 1 as well as Unit 2, however; the proposal stated that the water seal (recommended for the 2A pump due to the height of the RHR to charging pump piping) was not required for any of the Unit 1 charging pump suction line vents. Again, this served to reinforce the plant's position that the problem was limited to Unit 2, primarily 2B suction piping, and that the venting of all other pumps was an enhancement. The Westinghouse proposal did not identify the fact that the Unit 1 RHR to charging pump piping configuration was similar to 2A or that it was different from the B train RHR to charging pump suction piping.

On about 6-28-82, the plant staff received a summary report of testing performed on the 1B charging pump which observed some indication of gas voids in the pumpage. The plant staff was requested to initiate a Unit 1 PCR, similar to the Unit 2 PCR for venting the charging pump suction.

In a letter to file dated 12-29-82, the plant staff indicated that the request to initiate a Unit 1 PCR similar to the Unit 2 PCR for venting the charging pump suction was still being considered since the plant believed that the Unit 2 PCR may not be the best solution to the gassing problem in the charging system. Again, at this time, the plant's view of the problem was the venting of the pump suction, and the plant did not recognize a concern or the potential for hydrogen accumulation in the section of piping from the RHR to the charging pump suction.

On 3-2-87, the 1A charging pump was observed to have gas in the suction piping when it was started up after having been idle for approximately 19 days. The problem was not repeated, and the possible cause for the gas accumulation was identified as being due to a VCT pressure drop from approximately 20 psig to 15 psig due to the hydrogen pressure regulator failing at the hydrogen banks. It was believed that some gas came out of solution at that time forming a gas pocket in the A charging pump suction piping.

At that time, the only problem recognized by the plant to exist was in the 2B charging pump suction. The plant staff thus believed that the proposed solution would not work because it called for venting from the pump suction (which was felt to be at a lower pressure than VCT pressure if gas was coming out of solution) to the VCT gas space. Therefore, a PCR was not generated for Unit 1. Since the Unit 2B charging pump gas problem was being averted by running the 2B pump and, since no other charging pump on either unit had consistently shown any propensity for gas buildup in the suction header, the Unit 2 PCR was voided on 2/2/88.

Cause of Event

This event was caused by the piping configuration in that the layout of the A train supply line from RHR piping allowed hydrogen to accumulate. Normal suction for the charging pumps is from the VCT. The VCT contains an overpressure of hydrogen in equilibrium with the liquid. In general, the suction piping layout for each Unit 1 and 2 charging pump resembles an inverted loop (See Attachment). There is the potential for gas coming out of solution and migrating to these inverted loops.

For the Unit 1 A charging pump suction piping, the top of the inverted loop is at 109.5 ft. elevation. The RHR to charging pump suction header is connected to the top of the inverted loop and rises to elevation 133 ft. The vent used to vent the gas is located at this elevation. The Unit 2 A pump suction piping is similar to Unit 1 except the top of the loop is located at 114 ft. elevation. The high point and location of the vent in the RHR to charging pump suction header is at elevation 132.5 ft. Both of these geometries provide the conditions for trapping large amounts of hydrogen gas in the respective RHR to charging pump suction headers.

If hydrogen comes out of solution, it would accumulate in these A charging pump inverted loops. Review of the piping layouts identifies that the section of pipe containing the void is connected via a vertical pipe run to the charging pump suction piping at the top of the inverted loop. It is believed that hydrogen gas was evolving from the fluid and accumulating in the RHR to charging pump suction supply header, since this provided the high point in the system.

The B train (both Units 1 and 2) has a suction piping geometry which does not permit the voiding of large sections of piping, regardless of pump status. The geometry in these piping sections is such that any hydrogen evolving cannot be trapped and is therefore swept through the pump. This is due to the fact that there are no auxiliary lines (potential traps) connected to the suction piping at the top of the inverted loop. This is supported by the fact that the plant found no indication of hydrogen accumulation when venting the B train RHR to charging pump suction piping on both Units 1 and 2.

Reportability Analysis and Safety Assessment

This event is reportable because the A train charging pump for each unit was potentially inoperable for more than 72 hours. Technical Specification 3.1.2.4 requires that at least two charging pumps be operable.

It is noted that the location of the Unit 1 and 2 pump A void will have no effect on normal pump operations since this line is used only for safety injection recirculation. However, when going onto recirculation, if a void existed in this line, it might be pushed through the charging pump by the RHR pumps.

Westinghouse Pump Engineering and Pacific Pump identified the following concerns with passing this gas volume through the pump. The consequences on the pump are highly dependent on how the gas is mixed with the fluid prior to entering the pump. If the gas is not mixed and passes as a slug, the pump could experience a relatively long period of time (approximately 40 seconds) during which no water is available for pump lubrication. Given this worst case scenario, the pump vibration would significantly increase and cause rotating element internal rubbing and possibly seizure or shaft breakage. However, Westinghouse believes this scenario is very improbable since the hydrogen would normally be expected to mix with the water prior to reaching the pump suction.

With partial mixing, it is expected that enough lubrication is provided to prevent pump failure. However, any appreciable amount of gas in solution (greater than 5%) may result in a temporary imbalance in the loads on the impeller. This imbalance could be severe enough to the pump rotating element to cause rotor shaft bending and shaft crack initiation. Even if this occurs, Pacific Pump believes that the pump could continue to run for several days before shaft failure. At this time following an accident, the system is depressurized and the RHR pump would provide adequate core cooling.

The other consequence of passing a solution of part gas and water is that pump hydraulic performance will degrade during the time the mixture passes through the pump. Once all of the gas is purged, pump performance will recover. Westinghouse believes this is acceptable since pump performance is less stringent during recirculation than during injection. Therefore, a slight degradation of charging pump flow for a short period of time at the initiation of recirculation is acceptable.

*U.S.GPO:1986-0-624-538/455

The RHR pump to charging pump piping for both trains has been periodically vented since 3-2-88 in order to minimize hydrogen accumulation. Charging pump vibration spectrum data, as well as charging pump hydraulic performance data, were sent to Westinghouse for analysis. No trend or indication of pump problems or impending failure such as shaft failure was identified. Further evaluation is continuing.

There was no effect on plant operation and the health and safety of the public were not affected by this event. The amount of hydrogen that accumulated could possibly have caused damage to the A train charging pump if the recirculation phase of safety injection (i.e., suction from the containment sump via RHR pump to the charging pump) had been required. Normal charging pump operation and the injection phase of safety injection were not affected by the hydrogen accumulation.

Corrective Action

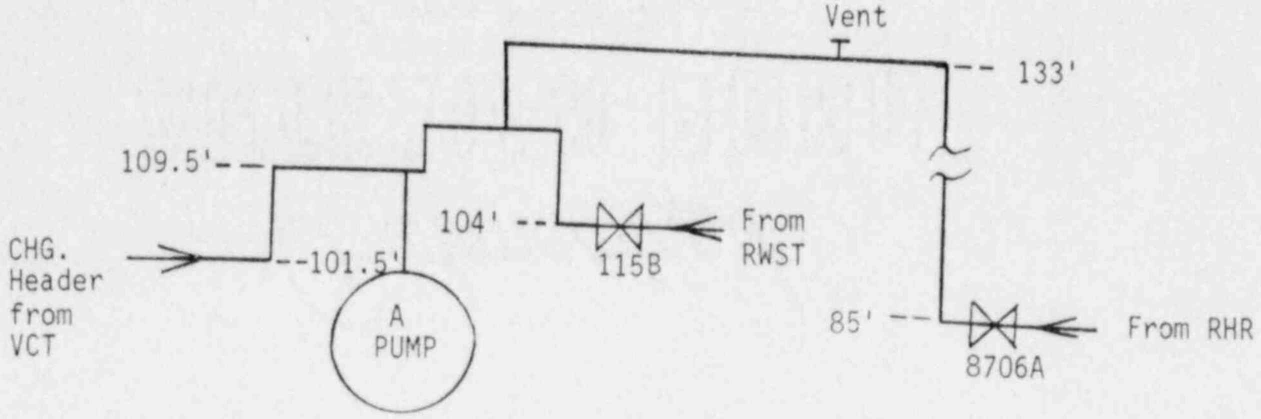
The normally operating charging pump on each unit has been established as the B or C pump because of the known propensity for gas accumulation in the supply line from the residual heat removal pump to the charging pump suction for the A train when the A pump is running. Periodic venting of the A train RHR to charging pump suction on both units will continue to minimize hydrogen accumulation.

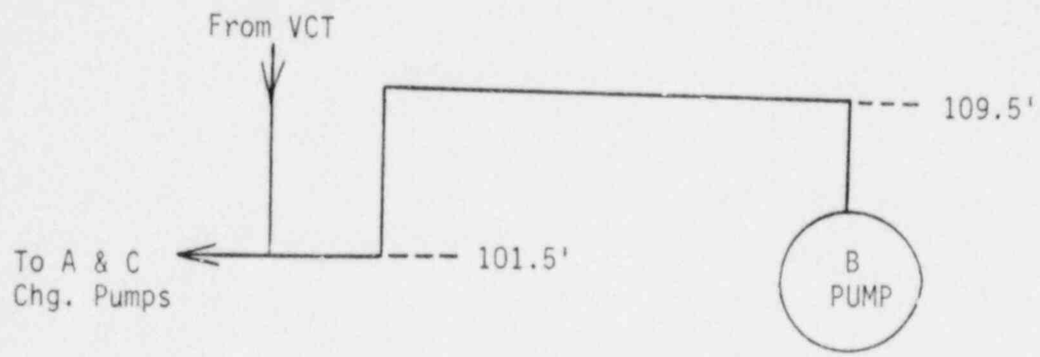
Design options will be evaluated to provide a long term solution to the accumulation of gas in the A train RHR to charging pump suction header on both units and in the Unit 2 B charging pump suction. The pump suction line configuration on all pumps will be evaluated and corrective action will be taken if determined to be necessary.

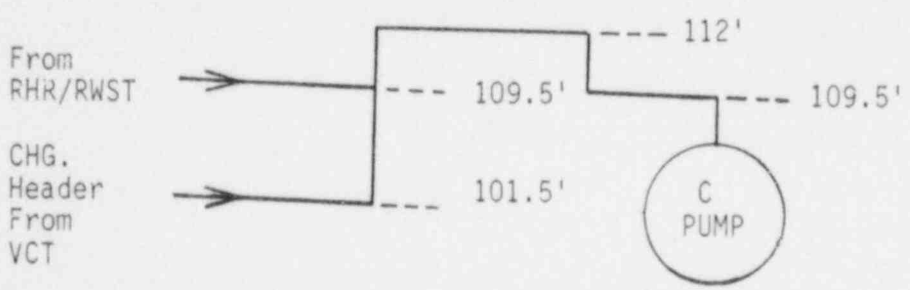
Additional Information

No components failed during this event.

Unit 1

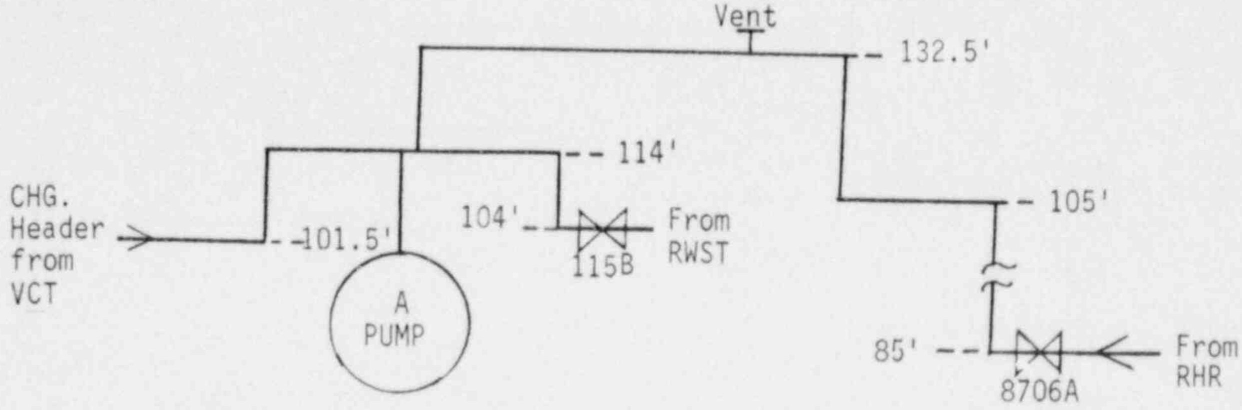


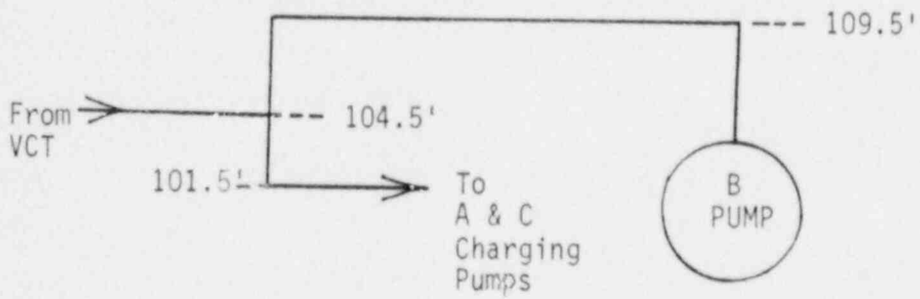


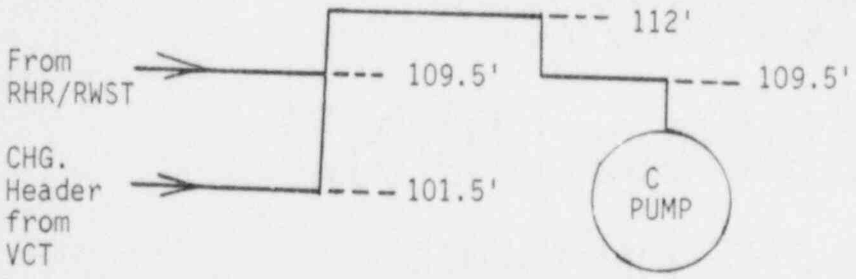


Note: The above sketches are schematics showing relative elevations.

Unit 2







NOTE: The above sketches are schematics showing relative elevations.

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R. P. McDonald
Senior Vice President

Alabama Power
the southern electric system

March 31, 1988

Docket No. 50-348

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Dear Sir:

Joseph M. Farley Nuclear Plant - Unit 1
Licensee Event Report No. LER 88-006-00

Joseph M. Farley Nuclear Plant, Unit 1, Licensee Event Report No. LER 88-006-00 is being submitted in accordance with 10CFR50.73.

If you have any questions, please advise.

Respectfully submitted,

R. P. McDonald

RPM/JAR:dst-V2.4

Enclosure

cc: IE, Region II

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